

Measuring Turbulence Mixing in Indonesian Seas using Microstructure EM-APEX Floats

Ren-Chieh Lien

Applied Physics Laboratory

University of Washington

1013 NE 40th Street

Seattle, Washington 98105

Phone: (206) 685-1079 fax: (206) 543-6785 email: lien@apl.washington.edu

Award Number: N00014-15-1-2318

LONG-TERM GOALS

Our long-term scientific goals are to understand the dynamics and identify mechanisms of small-scale processes—i.e., internal tides, inertial waves, nonlinear internal waves (NLIWs), and turbulence mixing—in the ocean and their interaction with oceanic processes at larger scales. We aim to develop improved parameterizations of mixing for ocean models. For this study, our focus is on the turbulence mixing in Indonesian Seas, the surface mixed layer processes, inertial waves and internal tides, oceanic responses to atmospheric forcing, and effects of oceanic processes on air–sea fluxes. The ultimate goal is to improve our understanding of the atmosphere–ocean coupled system in Indonesian Seas.

OBJECTIVES

The primary objectives of this observational program are to quantify turbulence mixing and identify dominant small-scale, upper ocean processes in the Indonesian Seas, and their modulation of sea surface temperature and air–sea fluxes.

APPROACH

Two microstructure EM-APEX floats will be deployed in Indonesian Seas. The observational sites will include the Banda Sea, Flores Sea, and south of Makassar Strait. We are proposing an innovative method to measure turbulence mixing in these regions, where vigorous diapycnal mixing activity is expected, using the autonomous microstructure EM-APEX floats. These floats measure turbulent thermal diffusion rate, horizontal velocity, temperature and salinity, vertical shear, stratification, and thereby the Richardson number. Estimates of turbulent kinetic energy dissipation rates and eddy diffusivity can be inferred. Microstructure EM-APEX floats were used in the prior ONR LatMix experiment, where they obtained quality microstructure and small-scale measurements.

WORK COMPLETED

In 2015, we attended the Year of the Maritime Continent (YMC) workshop at the National Center for Atmospheric Research (NCAR) and presented our experimental plan to deploy EM-APEX floats in the Banda Sea. We established a memorandum of understanding (MoU) and letter of agreement (LoA)

between Bogor Agricultural University and the Applied Physics Laboratory, University of Washington. We also obtained a foreign research permit from RISTEK (the Indonesian Ministry of Research and Technology). Our engineers have updated the EM-APEX float software and prepared test floats. Monsoon wind forcing, and thereby upper ocean mixing, is strongest during the boreal summer, and weakest in fall. We are in discussions with our Indonesian collaborators to determine the most appropriate cruise for the experiment.

IMPACT/APPLICATION

Oceanic processes in the Indonesian Seas play an important role in modulating the sea surface temperature and air–sea fluxes. Quantifying turbulence mixing and identifying dominant oceanic processes in the upper ocean of the Indonesian Seas will help improve our understanding of the ocean–atmosphere coupling processes and effects on Madden–Julian Oscillations.